Light and Lighting

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Incorporating "The Illuminating Engineer."

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The New I.E.S. Code

THE new I.E.S. Code, now being issued to members is an important departure in at least three distinct respects.

First, it deals in some degree both with Natural and Artificial Lighting.

Secondly, it gives some insight into *the basis* on which illumination values are determined, and illustrates by a special "I.E.S. Illumination Chart" how values should increase geometrically with the apparent size of the object to be seen, taking due account of the contrast involved.

Thirdly, it removes what has long been felt to be a weakness in the former Code, by including recommendation in regard to *quality* of lighting besides *intensity* (incidentally now specified in Lumens per square foot in preference to Foot-candles.)

The Code is to be fully discussed at the next I.E.S. meeting on November 13th. In the meantime I.E.S. members will doubtless endorse a congratulation to the President (Mr. H. C. Weston) on the remarkably good work he has done in this field.

Training in Illuminating Engineering

Readers will recall the appeal, in our July issue, for those interested in Courses in Illuminating Engineering to make known their needs. The present time is in some respects a difficult one in which to launch such an effort; so many of those who might be expected to benefit from courses are either already in the Forces or about to be called up. Nevertheless, we understand that there has been what must be considered an encouraging response. An enterprising step has now been taken by one educational institution in London, the Northampton Polytechnic Institute (St. John-street, E.C.1), which is starting a Course in Illuminating Engineering specially adapted to meet the needs of those desiring to take the examination of the City and Guilds of London Institute. The course is to commence in the first week of December next. Students will attend for three evenings a week, and enrolments (at a very moderate fee) can take place up to November 30. Those interested should get in touch with Mr. H. S. Barlow (Tel. CLE. 1662), who will be responsible for the course and will give any further information desired. We hope that firms in the lighting industry, and especially I.E.S. Sustaining Members, will do everything possible to encourage junior members of their staffs to take advantage of this opportunity.

"Modern Developments in Industrial Lighting

In addition to courses such as that mentioned above there is a need for shorter items of a more special nature. We note what seems to be an excellent series of six weekly lectures on the above subject, recently initiated by the Leeds College of Technology. The opening lecture on October 18, by Mr. George Black, M.B., F.R.C.S., was devoted to "The Eye." Subsequent items are "Lighting Fundamentals and Photometry" (Mr. J. E. Smith, October 25); "Electric Light Sources" (Mr. J. W. Howell, November 1); "The Design and Characteristics of Industrial Lighting Fittings" (Mr. W. R. Stevens, November 8); "Gas Lighting in Industry" (Mr. D. M. Thompson, November 15); and "The Planning of Industrial Lighting Installations (Mr. F. L. Cator, November 22). The fee for the course is only 15s. We certainly hope that the enterprise of the Leeds College of Technology will be rewarded by a good attendance.

Forthcoming I.E.S. Meetings

(Provisional List)

SESSIONAL MEETINGS IN LONDON

1945.

Nov. 13th. MR. H. C. WESTON on **the New I.E.S. Code.** (*At the E.L.M.A. Lighting Service Bureau, 2, Savoy, Hill, London, W.C.2.*) **6 p.m.**

Dec. 11th. DR. J. N. ALDINGTON on **Bright Light Sources (Part II).** (*At the E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, London, W.C.2.*) **6 p.m.**

MEETINGS OF CENTRES AND GROUPS

1945.

Nov. 1st. Address by the President (MR. H. C. WESTON). (*At the Institute of Engineers and Shipbuilders, 39, Elmbank Street, Glasgow.*) **7 p.m.**

Nov. 2nd. Address by the President (MR. H. C. WESTON). (*At Radiant House, Bristol.*) **7 p.m.**

Nov. 2nd. Joint Meeting with the Assoc. of Supervising Electrical Engineers. (*At the Imperial Hotel, Temple Street, Birmingham.*) **5.30 p.m.**

Nov. 2nd. MR. K. C. OLDHAM on **Signs and Display Advertising.** (*In the Lecture Theatre of the City of Nottingham Gas Dept., Parliament Street, Nottingham.*) **5.30 p.m.**

Nov. 5th. MR. P. HARTILL on **Illumination and Illusion.** (*At the Sheffield University, Western Bank, Sheffield.*) **6 p.m.**

1945.

Nov. 6th. DR. J. H. NELSON on **Motor Car Headlamps and the Prevention of Dazzle.** (*In the Electricity Showrooms, Market Street, Huddersfield.*) **7 p.m.**

Nov. 6th. Lighting from the Contractor's Standpoint. (*In the Demonstration Theatre of the Electricity Dept., Charles Street, Leicester.*) **6 p.m.**

Nov. 7th. DR. J. H. NELSON on **Motor Car Head Lamps and the Prevention of Dazzle.** (*At the Electricity Showrooms, The Headrow, Leeds.*) **6 p.m.**

Nov. 7th. MR. E. H. ELLIOTT on **Photometry.** (*At the Minor Hall, Oxford Street, Newcastle-on-Tyne.*) **5.45 p.m.**

Nov. 8th. MR. R. G. WILLIAMS on **Applied Colour Lighting.** (*At Newport, Mon.*)

Nov. 8th. MR. H. A. MILLER on **Cold Cathode Light Sources.** (*At the Liverpool Corporation Electricity Showrooms, Whitechapel, Liverpool.*) **6 p.m.**

Nov. 8th. MR. W. T. F. SOUTER on **The Lighting of Public Buildings.** (*In the Reynolds Hall, College of Technology, Sackville Street, Manchester.* **6 p.m.**

Nov. 9th. DR. J. H. NELSON on **Polarized Light—Some Practical Applications** (*At the Heriot-Watt College, Chambers Street, Edinburgh.*) **6 p.m.**

Nov. 16th. MR. W. J. G. DAVEY on **Short Cuts to Illumination.** (*Meeting of the Gloucester and Cheltenham Group. Meeting Place to be announced.*)

Nov. 29th. MR. D. A. STRACHAN on **Industrial Lighting.** (*In the Electricity Dept. Showrooms, Sunbridge Rd., Bradford.*) **6.45 p.m.**

Dec. 3rd. MR. N. SCHOFIELD on **Public Lighting.** (*At the Sheffield University, Western Bank, Sheffield.*) **6 p.m.**

Dec. 4th. MR. B. BLOW on **Tungsten Filament Lamps.** (*In the Demonstration Theatre, Leicester Electricity Dept., Charles St., Leicester.*) **6 p.m.**

(Secretaries of Centres and Groups are requested to send in particulars of any changes in programmes, mentioning subject, author, place, date and time of meeting; summaries of proceedings at meetings (which should not exceed about 250–500 words) and any other local news are also welcome.)

1945.

Dec. 5th. MR. R. O. ACKERLEY on **The Place of Science in the Art of Lighting.** (*In the Electricity Showrooms, Whitechapel, Liverpool.*) **6 p.m.**

Dec. 5th. MESSRS. G. R. HANSON and J. ROLPH on **Store and Shop Lighting.** (*In the Minor Hall, Oxford St., Newcastle-upon-Tyne.*) **5.45 p.m.**

Dec. 6th. MR. H. K. BOURNE on **Mercury Vapour Projector Lamps.** (*In the Sth. Wales Inst. of Engrs., Cardiff.*) **3.15 p.m.**

Dec. 6th. MR. J. G. HOLMES on **Methods of Glass Manufacture, etc.** (*At the Inst. of Engrs. and Shipbuilders, Elmbank St., Glasgow.*) **7 p.m.**

Dec. 6th. DR. J. N. ALDINGTON on **Bright Light Sources.** (*In the Great Hall, Manchester Coll. of Technology.*) **6.30 p.m.**

Dec. 7th. MR. A. L. RANDALL on **Maintenance and Operation of a Fluorescent Lighting Installation.** (*In the Electricity Showrooms, Bath.*) **7 p.m.**

1945.

Dec. 7th. DR. S. ENGLISH on **Illuminating Glassware.** (*In the Heriot-Watt College, Chambers St., Edinburgh.*) **6 p.m.**

Dec. 7th. MR. W. M. PEIRCE on **Modern Floodlighting Practice.** (*In the Lecture Theatre of the Gas Dept., Parliament St., Nottingham.*) **5.30 p.m.**

Dec. 10th. MR. N. SCHOFIELD on **Street Lighting.** (*In the Electricity Showrooms, The Headrow, Leeds.*) **6.0 p.m.**

Dec. 13th. MR. J. K. FRISBY on **Fluorescent Lighting.** (*In the Electricity Dept. Showrooms, Sunbridge Rd., Bradford.*) **6.45 p.m.**

Dec. 14th. MR. H. K. BOURNE on **Mercury Projector Lamps.** (*At the Imperial Hotel, Temple St., Birmingham.*) **6 p.m.**

Dec. 19th. A Brains Trust Meeting. (*In the Cleveland Scientific and Tech. Institution, Corporation Rd., Middlesbrough.*) **6 p.m.**

Dec. 20th. MR. E. G. PERNET on **Illuminating Advertising.** (*In Cheltenham.*)

Street Lighting

A paper on the above subject, by Mr. E. C. Lennox, is to be read at a meeting of the Institution of Electrical Engineers (Victoria Embankment, Westminster, S.W.) at 5 p.m. on Thursday, November 8. A cordial invitation has been issued to I.E.S. members to attend this meeting. Those intending to take part in the discussion are requested to get in touch with the I.E.S. Secretary, at 32, Victoria-street, London, S.W.1, from whom copies of the paper will be available shortly before the date of the meeting.

Research in Industry

An address on Research in Industry will be given by Dr. C. C. Paterson at the forthcoming meeting of the London and Southern District Junior Gas Association on November 23, 1945. The meeting will be held in Gas Industry House (1 Grosvenor Place, London, S.W.1), at 7 p.m. I.E.S. members will be welcome. (One notes with pleasure this instance of co-operation between the gas and electrical industries; incidentally, Dr. Paterson is, we believe, one of the very few experts who, besides being a distinguished scientist, is a full member, both of the Institution of Electrical Engineers and of the Institution of Gas Engineers.—Ed.)

Obituary

We regret to record the death of Mr. E. J. Ireland after a brief illness. For many years Mr. Ireland had been in the service of Holophane, Ltd., and he was recently appointed manager of their street lighting department. He was well known in the lighting industry and he will be missed by his many friends. His loss will be but especially by those associated with the I.E.S. Bath and Bristol Centre, of which he was chairman for the 1944-45 session, and for which he did much useful service.

Lighting and Health

Summary of Presidential Address delivered by Mr. H. C. Weston to the Illuminating Engineering Society in London on October 9, 1945.

At the opening meeting of the session on October 9 the I.E.S. met at the School of Hygiene and Tropical Medicine. Before the meeting commenced Dr. G. P. Crowden made a few remarks welcoming visitors, in the course of which he mentioned that the School is now incorporating lectures on Illumination in their regular courses, attended by medical officers and others concerned with public health.

In what follows we give a summary of Mr. Weston's address:—

This is the first peace-time session of the Society for six years, and we begin it with a membership of more than twice our pre-war strength. The history of lighting might have been very different but for the effects of wars in Europe centuries ago. One of these effects was the disruption of the civilisations of ancient Greece and Rome, followed as it was by centuries of cultural stagnation and retrogression. The Greeks had remarkable street lighting, for example, in ancient Antioch, but it is only in modern times that this amenity has been a feature of our own cities and, even now, there is much room for its improvement.

In the writings of the Roman poet Lucretius—who described the atomic theory of matter formulated by Greek philosophers—occurs what is probably the earliest description of glare. Yet, two thousand years after the death of Lucretius, glare remains one of the most common faults of lighting. Every effort should be made to eliminate it, and rules and practice for its avoidance are features of the new I.E.S. Code which is about to be issued.

There has been a steady rise, during the past 25 years, in the values of illumination recommended for good lighting. This rise has been facilitated by the falling running cost of artificial lighting, and has naturally been encouraged by the lighting industry. But the upward trend of recommended standards of illumination is justified by accumulating evidence of the effects of conditions of lighting upon human efficiency.

Personal efficiency, however, is one of the indices of health. There is no single and simple method of measuring health, and if we find that better lighting improves our efficiency it is because our health is improved. High personal efficiency is not a luxury, it is a sign of good health, and this is the proper objective for which conditions of lighting should be prescribed.

It is a great mistake to suppose—as some people do—that the meagre values of illumination available with artificial lighting in "the good old days" were dequate for comfort, health, and efficiency. Most of the fine work done by our forefathers—which so excites our admiration—was done in daylight, and some of the old craft guilds prohibited night work because it was likely to be bad work. Many people wore spectacles, especially when at work, or they used magnifying glasses; and serious deterrioration of vision seems to have been the rule among those engaged in fine work.

The new fluorescent lighting, which has proved such a boon to so many people in our war factories, and in other places where war service had to be done without any daylight, has not altogether escaped adverse criticism. Much of this is misconceived, and some is due to installation faults and neglect of maintenance. No satisfactory evidence that it has any ill-effects upon the eyes has yet been brought forward.

Bad or indifferent lighting is still widespread. It is responsible for much discomfort, strain, irritability, and loss of efficiency. Just because they are commonplace, these supposedly minor ill-effects of improper lighting are important. There is no need to look beyond them to find justification for our interest in the advancement of the science and art of lighting, and for the efforts of this Society to secure better lighting in every field.

Illuminating Engineering: A Profession

(Communicated)

The prestige of illuminating engineering as a profession has been in the minds of leading illuminating engineers for some time past, and the various Illuminating Engineering Societies, in this country, in Australia and in the United States have all been busy with plans for enhancing the status of members.

Professor H. H. Higbee, in discussing this question,* recalls that the American I.E.S. has recently established the new membership grade of Fellow, has created a technical secretaryship, and an illuminating engineering research fund, and is preparing an illumination design handbook. He stresses, however, the fact that the position of the completely independent expert is difficult; more and more he is coming to be a man working on a salary for a great public or private organisation. His activities, therefore, are governed to some extent by business considerations.

Applying this to the illuminating engineering field, Professor Higbee suggests that some of the best students in professional schools of engineering have turned away from illuminating engineering "when they learned how little incentive there was for technical ability and how much value was put upon sales ability without technical knowledge." He points to the danger that it may be considered better policy to get all possible profit out of a poor old idea before starting to develop a better new idea, and suggests if research laboratories were given encouragement they could have developed a lamp far superior to our present best.

These views were combated by Dr. Albert W. Hull, who pointed to the great advances made in the lighting field, which had done so much to reduce the cost of light, whereas the cost of most other commodities during the same period has greatly increased. (It might perhaps have been urged that every industry requires a breathing space in which to adapt itself to new developments, and that the instantaneous adoption of each new improvement as it came along, besides being commercially impracticable, might not prove in the best interests of the community.)

The broad question presented in Professor Higbee's contribution is a very debatable one, and applies not especially to illuminating engineering, but to all fields of industry.

It cannot be gainsaid, however, that the backbone of the illuminating engineering movement is the enlightened support of leading firms in the lighting industry, in whose ranks almost all those with expert knowledge of lighting are to be found. Yet it would be greatly to the benefit of a profession to include at least a substantial proportion of members who occupy an independent and impartial position. In illuminating engineering such experts are, even now, very few in number, but it was always recognised by the founder of the illuminating engineering movement in this country (Mr. L. Gaster) that progress towards the evolution of the ideal independent and fully qualified engineer would be slow. In the period since the birth of this movement—nearly forty years in this country—efforts have been necessarily directed first acquiring knowledge of illuminating engineering, secondly, in making the benefits of good illumination widely known. Only when these benefits have received general recognition will it become the rule for every Government Department, public authority or large commercial enterprise to employ a lighting expert in their service; and only when this stage is reached can the independent consulting illuminating engineer establish his position and earn a livelihood. Nevertheless, we are encouraged to believe that this stage may be reached ultimately, and is indeed already beginning to take shape.

* Illuminating Engineering, July, 1945, p. 414.

Colour Vision in Insects

The subject discussed at the meeting of the Colour Group, held at the Royal College of Science on September 19, was an unusual one, viz., our knowledge of the way in which insects of various kinds react to different colours. The lecturer was Dora R. Ilse, D.Phil. (Goett.), F.Z.S., of the research laboratories of Reckitt and Colman, Ltd., who illustrated her remarks with a number of colour films showing certain types of experiments used in her investigations.

The lecturer was at pains to emphasise, at the outset, that in studying reactions of insects to colour, there were a number of pitfalls which beset the investigator who failed to free himself from notions derived from his knowledge of the colour vision of man. For example, there was no *à priori* evidence that the visible spectrum for insects was the same as that for man, or that the spectral composition of white light would be identical. She defined the "colour discrimination" of an animal as its power to distinguish one part of its visible spectrum from another, independently of any brightness differences.

As no two species of insect were alike in their reaction to colour stimuli there was no general method of investigation applicable to the study of all types of insects. Most differential responses to different regions of the spectrum could be completely compensated by an adjustment of brightness, and so were not responses to wave-length specifically. This held, for example, in the case of the phototactic response of certain insects, i.e., movement towards or away from the brighter of two lights. This response, however, had been used to determine the luminosity curves of a number of insects, and it had been found that they resembled the curve for the scotopic (dark-adapted) human eye, but extended into the ultra-violet.

Experiments using inborn differential responses to different colours, independent of variation of intensity, gave a number of interesting results. Some experiments of this type with the cabbage white butterfly were shown on the screen. For feeding purposes, this insect showed a marked preference for colours other than green and avoided white, whereas for egg-laying green was invariably selected. On the other hand, the peacock butterfly seemed to prefer greys.

More detailed results could be obtained with insects in which memory was more highly developel and which could, therefore, be trained to search for food on almost any colour. Kühn carried out many experiments on these lines with the honey bee, and two interesting films were shown based on his experiments. It was found that bees fed on a blue area, for example, would select blue, purple, or violet patches and avoid other colours. An interesting extension of this was to the contrast phenomenon of the apparent colour of a grey ring on a coloured background. Bees trained to select blue would settle on a grey ring placed on a yellow background, showing that the contrast effect was similar to that in man.

By means of a long series of experiments of the kind shown, it had been found that honey bees, within their visible spectrum (650 to 300 m.), could distinguish at least four spectral intervals, the first and third, as well as the second (bluish green) and fourth (ultra-violet) being complementaries for their eyes.

The lecture was followed by an interesting discussion and the examination, by those present, of some demonstrations with actual insects given by the lecturer

I.E.S. Transactions: Erratum

We are asked to draw attention to a clerical error which occurred in the address on "Daylight and its Penetration into the Sea," by Dr. W. R. G. Atkins (Trans. Illum. Engg. Soc, Vol. X, July, 1945). On p. 142, 14th line from bottom, for "8,000 tons per sq. km." read "3,000 tons per sq. km."

Lighting for Recreation

The Huddersfield Group of the Illuminating Engineering Society had a rather unusual paper by E. P. Mawson, F.R.I.B.A., at their opening meeting of the 1945-1946 Session on Tuesday, October 2, 1945.

In a paper entitled "Planning for Recreation with Special Reference to Lighting," Mr. Mawson dealt with the design of Parks and Recreation Areas, illustrating how derelict areas could be planned for public parks, incorporating playing fields, sports areas, etc., while retaining the beauty of the parks for passive recreation.

The question of lighting these areas was an important factor if children could be taken from the streets and kept in these playing areas after dusk. Not very much had been done in the past—probably owing to climatic conditions. It was suggested, however that this was a matter well deserving consideration in the future.

In view of the fact that the lighting of open-air sports areas is not generally carried out in this country, data was given by Mr. Mawson on the lighting of similar areas in America. (Some of these figures are assembled in the accompanying table.)

Tennis courts can be lit with ten units of lighting per court, mounted on 30 ft. standards, with 20 ft. spacing, using 1,500 watt lamps and deep reflectors. Should the courts be required for championship purposes, however, the size of lamps should be increased to 2,500 watts. Football grounds could similarly be lit with flood-lights mounted on large towers 70 ft. high, each tower containing a flood-light of 1,500 watts. Mr. Mawson then illustrated by lantern slides, many derelict areas which had been converted to parks, especially one notable area in Stanley Park, Blackpool. Mr. Mawson concluded the lecture by showing many other parks and recreational centres which he had planned.

The meeting ended with a vote of thanks proposed by Mr. J. T. Thornton.

Many of the leading architects of the town attended the meeting, and their thanks were expressed by Mr. N. Culley. There were present a total of 41 members and visitors. Mr. E. Lunn, Chairman of the Group, presided.

Sports	Number of Units	Lamp Size	Spacin	Mounting Height
Tennis	Arrange 10 units per court.	1,500 W.	20 ft.	30 ft.
Bowls	Ten units per 6 rinks.	750 W.	40–45 f	20 ft.
Hockey (Ice)	Six to 12	1,500 W.	40–60 f	30 ft.
Volley Ball	Six	1,000 W.	7 ft. from	20 ft.
Croquet	Four	White Bowl 500 W.	30 ft. ap 36 ft.	16 ft.
Quoits	Two units for 4 pits.	White Bowl 200 W.	—	10 ft.
Race Tracks	Depends on size of track.	White Bowl 1,000 W.	100 ft. on i of track	30 ft.
Bathing Beaches	Depends on area to be lighted.	1,000 W.	400 ft. bet groups of li	—
Football	About 15 floodlights per Tower, 4 Towers.	1,500 W.	—	At least 70 ft.
Trap Shooting	Four projectors.	1,000 W.	*See* rema	20 ft.
Average Swimming Pool ...	Depends on size of Pool.	750 to 1,000 W.	30–40 f	20 ft.

Glass in the Service of Light

At the opening meeting of the I.E.S. Sheffield Centre on October 9 the new chairman, Dr. A. J. Holland, gave an address on "Glass in the Service of Light," in the course of which many applications of glass with light-sources were described and illustrated. Dr. Holland emphasised especially the severity of the conditions to which glass may be subjected with modern lamps—for example, those taking currents in excess of 100 amps. By the aid of lantern slides many forms of enclosing glass globes and shades were shown—in which connection Dr. Holland remarked on the fact that the popular bowl fitting in use in many homes to-day differed little in craftsmanship from the sculptured glass-bowl fittings manufactured in the 10th century. In spite of technical advances our tastes in regard to decoration had not materially changed.

In the course of the meeting, which took place at the Victoria Station Hotel, the retiring chairman, Mr. W. G. Thompson, conveyed his thanks to the Officers and Committee for their efforts during the session. He emphasised the happy collaboration which existed with the Leeds Centre. Mr. Houldsworth (Chairman of the Leeds Centre), in moving a vote of thanks to the lecturer, congratulated the Sheffield Centre on its choice of Chairman.

Personal

Amongst those appointed by the Lord President of Council to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research is Dr. C. C. Paterson, F.R.S.

Mr. W. C. Huston, Manager of the B.T.H. Lighting Section, a position which he has held since 1939, has been appointed a Director of Harcourts, Limited, which is one of the A.E.I. group of companies. Mr. Huston is a Member of Council of the Illuminating Engineering Society, with which he has been associated for a number of years.

Mounting Height	Type of Unit	Location of Units and General Remarks
30 ft.	Deep Bowl	If courts are to be used for championship matches 2,500-W. lamp should be used.
20 ft.	Elliptical angle Reflector	Units to be placed 5 ft. from the edge of the Green.
30 ft.	Angle Reflector dimensions	Evenly spaced along two sides of a large-sized Rink (100 × 200). If Rink is medium (112 × 58) three 1,000-W. units on each side.
20 ft.	RLM Dome	Use 4½-ft. bracket-arms on poles.
16 ft.	RLM Dome	End units placed 12 ft. from end Boundaries, use 4½-ft. brackets on poles.
10 ft.	RLM Dome	Supporting pole is placed behind and midway between 2 adjacent pits. Use 6 ft. arm brackets.
30 ft.	RLM Dome	Placed on inside of track. Use 12-ft. brackets.
—	Floodlights	Recommended method employs 25 W. per lineal foot of beach.
At least 70 ft.	Large flood-lights	Distance from a group of Floodlights to playing field should not exceed 100 ft. Towers arranged systematically.
20 ft.	Floodlight projectors	Units located 18 yards behind the shooters' stand. Reflectors to be so directed that course of clay pigeon is clearly illuminated.
20 ft.	RLM Dome	Systematically spaced over pool area.

Lighting and Decoration in an Underground Factory

by

Brigadier P. W. L. BROKE-SMITH, C.I.E., D.S.O., O.B.E., and F. A. HULCOOP, A.M.I.E.E., F.I.E.S.

Blackout restrictions imposed at the beginning of the war caused considerable interference with admission of daylight and also with natural ventilation in factories. The factories most seriously affected were those where production had to continue throughout 24 hours per day without interruption. In cases where the blackout was necessarily of a permanent nature and in factories where night shifts were worked, it soon became apparent that as close an approach to normal daytime working conditions as possible should be provided by artificial means. This, indeed, was essential in order to maintain the morale of the workpeople and to avoid excessive sickness and fatigue due to the blackout conditions. Such measures were taken in above-ground war production factories to a considerable extent with consequent benefit to the morale and health of the workpeople and to production.

Underground Factories

In order to ensure uninterrupted production of munitions or apparatus particularly essential to the war effort by affording protection from the heaviest air attack to both workers and plant, certain factories were constructed underground. In such factories the necessity for the highest standards of lighting and ventilation was, of course, most cogent.

The underground factory at Westwood Quarry, Wiltshire, operated by the Enfield Cycle Co., Ltd., furnishes a striking example of the successful solution of the difficult problem of reproducing normal factory working conditions by artificial means. This factory was located in the disused workings of the quarry, which are approximately 80 ft. below the surface. The first steps required to bring it into operation were clearing of the workings and the provision of a solid concrete floor over areas to be used for manufacturing processes and storage. It was also necessary to brick line portions of the galleries and erect brick piers to support the roof. Special arrangements to divert and drain small underground streams and dispose of sewage were necessary, the latter being dealt with by two compressed air sewage ejectors. As the head room is limited to 7 or 8 ft., pits were sunk in the floor to accommodate heavy and tall machines such as radial drills and grinders, jig borers, etc.

Manufacturing Processes

In general the manufacturing processes may be classed as light to medium machining, but much of the work is to fine limits calling for high precision tools and skilled operators. All types of tasks usually associated with light engineering are represented, including gear and worm cutting, grinding, rust-proofing, and shot blasting. Tolerances of a fraction of a ten-thousandth of an inch are not uncommon and, in some cases, limits in micro-inches are imposed, and lighting sufficient in quantity and quality is obviously essential for working to and making such fine measurements. The maintenance of an even temperature throughout the factory also greatly assists in obtaining the necessary degree of accuracy.

Ventilation is satisfactorily achieved by two intake fans each of 60,000 c.f.m. capacity, drawing air from the surface and distributing it by ducting to all parts of the factory. Stale air and fumes are removed by three extract fans of 30,000 c.f.m. each.

Heating of the factory is by Plenum

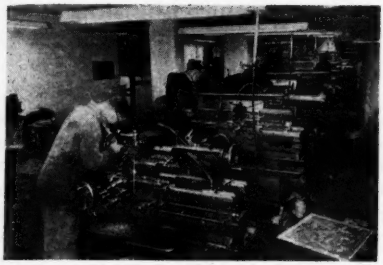

Fig. 1. Each machine is provided with a 5 ft. fluorescent tubular lighting fitting, and the pleasing appearance of this rather crowded section can be judged from the photograph. The absence of local lighting is noteworthy.

system, which tempers the incoming air by the use of hot water from coke-fired boilers. The heating is controlled and permits the fullest utilisation of the heat emission from machines and production processes.

Lighting Arrangements

The lighting of the factory needed special treatment since the dimensions of the working arrears are so diverse from those met with in surface buildings. In effect the underground workshops are flat-roofed tunnels, possibly 20 or 30 ft. wide, 7 or 8 ft. high, and anything up to 70 or 80 ft. long.

The factory is approached by an adit 460 ft. long, 12 ft. wide, and 7 ft. 6 in. high, lit by means of prismatic bulkhead fittings with tungsten lamps,

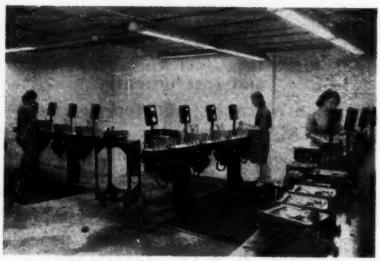

Fig. 3. The lighting over these test benches is arranged to give excellent uniformity, without glare, enabling the meter scales to be easily and clearly seen.

providing an illumination value of 1 to 2 ft.c.

Within the factory 5 ft. fluorescent tubular daylight lamps are exclusively employed, and over the working areas an average value of 20 ft.c. is provided, with a lower value varying between 12 to 15 ft.c. for corridors and passages.

Colour of Decoration

The colour for the walls and roof was decided after considerable experiment. It was found that the most pleasing results, having regard to the need for a high efficiency, were obtained from a white distemper finish with a slight pink tinge giving a reflection factor of 80 per

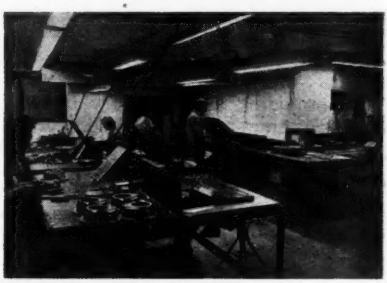

Fig. 2. Adequate illumination is provided for critical seeing in the inspection section, part of which is shown above. The stone wall, as left from quarrying operations, and a portion of the ventilating ducting can also be seen.

cent. A light cream paint, with a reflection factor of 70 per cent., has been applied to all ventilation duct work, conduits, electrical, and other factory fittings. The lower paintwork, such as doorways, etc., is a bright, cheerful green, which is restful to the eyes.

The lighting fittings, finished white all over, have a cut-off approximately 5° below the horizontal, which avoids to a large extent objectionable shadows at the tops of the walls and, owing to the relative narrowness of the tunnels, reflection from the walls illuminates the roof sufficiently to overcome any sense of oppression from the low head room.

The general effect of the lighting arrangement is to give an air of spaciousness and in no small measure assists the maintenance of cleanliness

and order which are the marked features of the factory.

In one small portion of the factory the walls and paintwork were redecorated by a contractor who was unaware of the evolution of the original colour scheme. In this area the walls were coloured white with a blue tinge, reflection factor 85 per cent., and the duct work a medium stone colour, reflection factor 65 per cent. Although the efficiency of the wall surfaces in this part of the factory was higher, from the lighting standpoint, than those elsewhere, the psychological effect was not so good, and it was necessary to introduce the same colour scheme here as that described for the remainder of the factory.

Illumination Provided

By providing a satisfactory intensity on both the horizontal and vertical planes, the need for local lighting has been almost completely eliminated, and only in very special instances has supplementary local lighting been provided.

The surgery, where the few slight accidents occurring in the factory are treated, is lighted to a value of 30 ft.c. by means of 5 ft. fluorescent tubular lamps, and the rest room, where the colour scheme is salmon pink walls (reflection factor 55 per cent.) with grey woodwork, is provided with one fluorescent tubular fitting adapted to give either direct or indirect lighting of 8 or 2 ft.c. respectively. Local lighting is also provided.

Sunray treatment is available for any who wish to avail themselves of the service and vitamin capsules are also supplied to the workpeople in the winter to compensate for the lack of daylight and sunshine.

No complaints of eye strain, excessive fatigue or abnormal sickness have been recorded, which, in view of the fact that the workers are underground for not less than 10 hours per day, bears adequate testimony to the excellent working conditions which have resulted from the careful planning of lighting, ventilation, heating and decoration before the factory came into operation.

Fluorescent Lighting at Piccadilly Tube Station

Travellers on the Piccadilly Tube cannot have failed to be struck by the recently installed fluorescent lighting at the station from which the tube takes its name. One platform, lighted in this manner, makes a remarkable contrast with the adjacent one, lighted by the old method. Not only is the illumination much higher, but the effect on the walls much stronger, so that the whole tube appears flooded with light. Apparently about twenty double tubes, mounted centrally near the roof along the line, are used. Compared with the ordinary lighting of adjacent stations and passages the daylight effect comes as a great surprise. One can hardly wonder at the report that travellers, sunk in abstraction, occasionally dash for the doors in the belief that they have come out into actual daylight and their journey is ended.

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Circuits For Discharge Lamps

By R. MAXTED *(Fellow)* and J. N. HULL *(Member)*

(Trans. Illum. Eng. Soc. (Lond.), October, 1945)

It will be recalled that in view of the situation created by the Paper Restrictions, it has been decided to limit the distribution of this issue of the Transactions, which will be sent to the libraries and such bodies as require the Transactions for permanent reference, but only to those I.E.S. members who make application for it (which all members who are in the habit of retaining copies and binding them in volume form will naturally do).

Members who wish to receive the October issue of the I.E.S. Transactions, which will be available very shortly, are accordingly requested to fill up and return to the Hon. Secretary the attached form.

It will be recalled that similar procedure has been adopted in regard to other papers of a lengthy and somewhat specialised nature. Besides easing the situation in regard to paper, this practice may facilitate the publication of more papers of wide and general interest.

This form to be returned to the Hon. Secretary of the Illuminating Engineering Society, 32, Victoria Street, London, S.W.1.

I.E.S. Transactions, October, 1945.

Please send me the issue of the Transactions for October, 1945, containing the paper entitled "Circuits For Discharge Lamps," by Mr. R. Maxted and Mr. J. N. Hull.

Signature of Member.....

.....

Name and Address to which copies should be sent. .....

In clear block letters. .....

.....

Lighting Reconstruction Pamphlets

Readers are reminded that copies of the series of Lighting Reconstruction Pamphlets are still available on application to the Illuminating Engineering Society (32, Victoria-street, London, S.W.1).

It will be recalled that the first five of the series are all available at the same rate (single copies 1s. each, 9s. per dozen, £3 per 100). The titles are as follows: No. 1, "The Principles of Good Lighting"; No. 2, "The Lighting of Public Buildings"; No. 3, "The Lighting of Schools"; No. 4, "Natural Lighting"; No. 5, "Public Lighting in the City and Highway."

The sixth of the series, "Making Work Lighter," which carries illustrations by Fougasse, is issued at the special flat rate of 6d. a copy.

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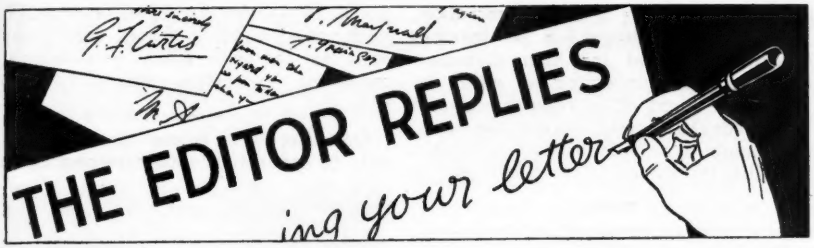

Readers interested in **books on electric discharge lamps** and fluorescent lighting will be glad to hear that this is to be the subject of a forthcoming treatise by Professor H. Cotton (a leading member of the I.E.S. Nottingham Centre), which will be published shortly by Chapman and Hall, probably before the opening of 1946.

I frequently receive inquiries for **books in the I.E.S. library** and occasionally surprise is expressed that there have been so few additions since the outbreak of war. This is explained partly by the difficulty, under war conditions, in obtaining books from abroad —but mainly by the circumstance that, in fact, very few books on illumination and photometry have recently been published.

In particular there is a dearth of **treatises on specific aspects of lighting** (e.g., in streets, factories, schools, homes, etc.). I have suggested in the past that relatively compact books on such social subjects, cheaply produced and in such a manner as to be readily revised and reissued, are likely to fill present needs better than ponderous and expensive volumes. This may well be taken to heart when conditions in the publishing business are less stringent.

I have been asked to obtain an article reviewing the problem of **releasing atomic energy** and discussing its possible **application to lighting technique** in the future. I have not given up hopes of doing so, but the first authority whom I approached regarded the latter prospect as absurdly visionary—even in the mind of a journalist!

I confess I do not see why the question should be so summarily dismissed. Applications of atomic energy to other fields—for power stations and on railways—are being discussed. Why not to lighting? It may be that the intense light accompanying an atomic explosion is merely a by-product, but if the rate of development of energy can be eventually controlled, may not the control be in some degree selective? In the familiar example of **"luminous paints" stimulated by emanations from radium compounds** we have surely an example of this very thing—a slow atomic disintegration and its application to the production of a steady light.

I have received a letter from Dr. W. R. G. Atkins confirming my recent remark in regard to the value of **windows glazed with glass transmitting ultra-violet.** He agrees that in ordinary office buildings this is of very debatable value and submits a calculation to show that six minutes in the open air (during the lunch hour) will provide exposure to far more ultra-violet radiation than ten hours in an office—even if equipped with special glass.

On the other hand, where the site and mode of design make possible a high daylight factor, matters are different. Thus Dr. Atkins prepared a small rest-house composed mainly of glass transmitting u.v. radiation freely with good effect, and no doubt the same applies to glass enclosures for horticulture.

I have been asked to give other ex-

amples of the value of **good illumination** in facilitating **observation of moving objects.** The need for high illuminations in games involving an effort to follow the flight of a rapidly moving ball is admitted, and I imagine the same must apply to some industrial operations in which things are in rapid motion.

In such cases, however, we are inevitably concerned with high illuminations. It is only **when the illumination is relatively low** that we may be **deceived,** i.e., unable to say whether or not an object is in motion or at rest—obviously a dangerous condition. This might arise with moving machinery, i.e., flywheels, if the illumination were low enough, but this is not very likely. I have instanced the appearance of **escalators** in weak war-time illumination. In some cases it was definitely difficult, as one approached it, to see whether the escalator was in motion or not, and one felt correspondingly uncertain as to one's footing. Another instance that has come before my notice is **running water.** Streams are often difficult to distinguish in the twilight if running smoothly. I have observed that in feebly lighted lavatories it may be difficult to *see* whether a tap is running or not, though the sound may give a clue.

On the debatable **point in style** mentioned in our August issue (p. 117), Dr. Walsh suggests that certain adverbs, if to be intensified, are often qualified by some particular adverb. We never say "I am very obliged," but always "I am much obliged," but usually, "I am very pleased," not "I am much pleased." We may intensify further by introducing "very" ("I am very much obliged"), but this cannot usually be done if that is the adverb already employed. In the one case one starts with "much" and may then add "very," but if one starts with a "very" one can go no further—though "very very" is not unknown.

Mr. G. F. Freeman inclines to the view that "very" qualifies "much," not vice versa. In support of this he quotes his small daughter who, in referring to helpings of pudding, stated that "they were not the same much"—an original mode of expression which has its points!

On reflection I would point out it is only in connection with past participles that this difference in usage arises. "**Very**" can apparently be used with **all adjectives,** but "much" never. On the other hand there seem to be very few, if any, past participles with which "much" cannot be used, though there are certainly many with which "very" alone sounds wrong—in fact, to my ear it almost always does so.

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LIGHTING FITTINGS DESIGNER, British, required for Central London by large manufacturers. Commercial and industrial, lighting equipment for tungsten, fluorescent and discharge lamps. Electrical and illumination training and experience essential. Medical examination.—State salary and full particulars to Box No. 151, "Light and Lighting," 32, Victoria-st., London, S.W.1.

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ICS

Fluorescent Lamps for Shop and Store Lighting

The demands of war production have, so far, restricted the use of fluorescent tubular lamps to industrial purposes, but they have manifest advantages in many other fields, for example, in shop and store lighting. Here the rendering of colours is an important item.

Fluorescent lamps are at present available in two tints, "daylight" and "warm white." Both have their uses, but the former is of special utility for such purposes as matching stockings or ribbons or selecting cloth, displaying furs, etc.—even though the similarity to daylight is not sufficient for very accurate colour-matching purposes. This quality is effectively utilised in a colour display at D. H. Evans, Ltd. (London), where Osram fluorescent lamps have been installed.

The light from fluorescent lamps being visually so similar to daylight is admirably adapted to reinforce it, and, in combination, a great asset in large stores in cities where it is often most difficult to provide adequate daylight in all parts on all the floors.

The good qualities of these lamps should not, however, be abused. It is not expedient to use them unshielded at low mounting heights; for although the brightness is relatively low the total volume of light may be very considerable.

Because of the large area and low brightness of fluorescent lamps shadows are soft and risks of either direct or reflected glare are greatly reduced. The cool nature of the light and its resemblance to daylight are also great advantages. Colours can be judged without its being necessary to carry samples to shop doors before a selection is made.